

**THE TAXONOMIC POSITION
OF IRVINGIOIDEAE, ALLANTOSPERMUM
FORMAN AND CYRILLOPSIS KUHLM.**

par H. P. NOOTEBOOM

Laboratory for Experimental Plant Taxonomy, Leyden

SUMMARY : Recently FORMAN (1965) combined the simaroubaceous subfamily *Irvingioideae* (or *Irvingiaceae* according to some authors) with *Ixonanthaceae*, a family related to *Linaceae* sensu stricto. He treated *Ixonanthaceae* as comprising two subfamilies, *Ixonanthoideae* and *Irvingioideae*. In the same paper he described a new genus, *Allantospermum* Forman, which he included in his *Ixonanthaceae-Ixonanthoideae*.

In this article arguments are put forward to retain *Irvingioideae* in the *Simaroubaceae* and to include *Allantospermum* in this taxon.

The genus *Cyrillopsis* Kuhl., placed in *Cyrtillaceae* by its author and transferred to *Irvingiaceae* by ROBSON & AIRY SHAW (1962), undoubtedly belongs to *Ixonanthaceae* sensu stricto as FORMAN already concluded.

The genus *Cleistanthopsis* Capuron (1965) turned out to be congeneric with *Allantospermum* Forman.

Besides morphological features some anatomical and chemical characters are discussed briefly.

SOMMAIRE : Récemment M. FORMAN (1965) a réuni les *Irvingioideae* (ou *Irvingiaceae* selon certains auteurs), sous-famille des Simaroubacées, aux *Ixonanthacées* famille qui se rapproche des Linacées. Il a donné à ce groupe le rang de sous-famille.

Dans cet article nous proposons de garder les *Irvingioideae* dans la famille des Simaroubacées et nous apportons des arguments pour faire entrer le genre *Allantospermum* dans les Irvingioïdées. Les genres *Cleistanthopsis* Capuron (28-7-1965) et *Allantospermum* Forman (26-7-1965) paraissent être congénériques.

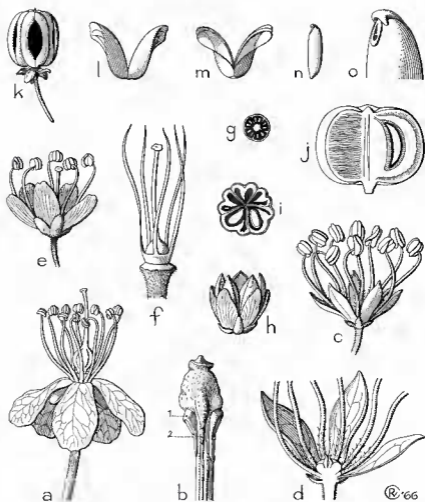
Le genre *Cyrillopsis*, Kuhl., placé par MM. ROBSON et AIRY SHAW dans la famille des Irvingiacées, appartient sans aucun doute aux *Ixonanthaceae*, sensu stricto, comme M. FORMAN l'avait déjà indiqué.

Outre les caractères morphologiques, nous avons brièvement discuté quelques caractères anatomiques et chimiques.

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INTRODUCTION

The simaroubaceous genera *Irvingia*, *Klainedoxa* and *Desbordesia* were united into the subfamily *Irvingioideae* by BOAS (1913). ENGLER too treated this taxon as a subfamily of *Simaroubaceae*. PIERRE (1892) already had given this alliance family rank; he placed his Irvingiacées next to *Anacardiaceae*. VAN TIEGHEM (1905) also accepted Irvingiacées and considered them close to, but distinct from *Simaroubaceae*. HALLIER



Pl. 1. — *Allantospermum borneense* Forman : **a**, flower × 3,6 (S 3364); **b**, apical part of columella × 2,75, **b-1** placenta with scar of removed seed, **b-2** placenta with aborted ovula (S 15162). — *Allanthus triphyss* (Denust.) Alst. : **c**, flower × 3,6; **d**, l.s. of flower × 7,2 (Csl. V 127). — *Ochthocosmus africanus* Hook. f. : **e**, flower × 3,6; **f**, ovary filaments × 7,2; **g**, c.s. of ovary × 7,2 (Louis 1849). — *Ochthocosmus sessilifolius* Baill. : **h**, fruit × 2; **i**, c. s. of fruit × 2,75 (Courlet 903). — *Klaineodoxa gabonensis* Pierre : **j**, l.s. of fruit acc. to Engler (1931) fig. 185 E. — *Allantospermum multicostul* (Capuron) Nootboom : **k**, young fruit × 1,2; **l**, **m**, carpels after debiscence × 1,2; **n**, seed × 1,2; **o**, apex of seed with arilodium and hilum × 6 (23944-SF).

(1923) included *Iringia* in his *Linaceae* (comprising a.o. *Erythroxyloaceae*, *Ixonanthaceae* and *Humiriaceae*), next to *Erythroxyloaceae*. HUTCHINSON (1959) accepted HALLIER's ideas by placing *Iringiaceae* in his order *Malpighiales* near *Ixonanthaceae*, *Humiriaceae* and *Linaceae*. Finally FORMAN included *Iringioideae* in *Ixonanthaceae*.

Allantospermum, was placed in *Ixonanthaceae-Ixonanthoideae* by FORMAN. *Cleistanthopsis*, which turned out to be congeneric with *Allantospermum*, was placed in *Iringiaceae* by CAPURON.

The taxonomic position of *Iringioideae* and of *Allantospermum* is still uncertain.

Ixonanthaceae, formerly a subfamily of *Linaceae* (WINKLER in ENGLER (1931, p. 123) was already treated as a separate family by PLANCHON [« *Ixonantheen* », Planchon ex Klotzsch (1857)], a view accepted by EXELL and MENDONÇA [*Ixonanthaceae* Exell & Mendonca (1951)], and by HUTCHINSON (1959, p. 256).

The main morphological features of the taxa discussed are summarised in table 1.

CYRILLOPSIS Kuhlms.

FORMAN (1965) included this genus, together with *Allantospermum*, *Ixonanthes*, *Ochthocosmus* and *Phyllocosmus* in his *Ixonanthoideae*. I fully agree with Forman. The lateral stipules and the flower characters of *Cyrillopsis* clearly point to *Ixonanthaceae sensu stricto*. At the same time the chromatographic patterns of hydrolysed leaf extracts resemble closely those of *Ixonanthes* and *Ochthocosmus* (table 2). The inclusion of *Cyrillopsis* in *Ixonanthaceae* requires adaptation of the definition of the family to account for the 2-locular ovary of *Cyrillopsis*. In all taxa discussed here the ovaries are rather variable.

ALLANTOSPERMUM Forman

FORMAN (26 July 1965) described the monotypic genus *Allantospermum* from Borneo and placed it in his *Ixonanthoideae*. Independently and one day later, CAPURON (27 July 1965) described a new, monotypic, genus from Madagascar, *Cleistanthopsis*, which he considered to belong to *Iringiaceae*.

After having studied FORMAN's and CAPURON's descriptions and diagnoses as well as material of both genera, it became clear to me that the two species must taxonomically be treated as congeneric. They agree completely in essential leaf, flower and fruit characters.

I therefore reduce herewith *Cleistanthopsis* Capuron to *Allantospermum* Forman, and its only species, *Cleistanthopsis mullicaulis* Capuron is herewith renamed *Allantospermum mullicaule* (Capuron) Nootboom *comb. nov.* (Type 23640-SF).

The study of both species of *Allantospermum* and a good acquaintance with *Simaroubaceae* including *Iringioideae* convinced me that the

views hold by CAPURON regarding the affinities of *Allantospermum* are more likely to fit with a natural system than does FORMAN's classification.

According to FORMAN *Allantospermum* shares with *Irvingiaceae* the floral characters, but agrees with *Ixonanthaceae* by having capsular fruits and seeds with an aril. In my opinion, however, the loculicidal fruit of *Ixonanthaceae*, which does not leave a columella after dehiscence, and bears two seeds (sometimes 1 aborted), separated by a false sept, in each cell, differs fundamentally from the fruit of *Allantospermum* (Pl. 1, k t/m n). The latter resembles much the 5-celled drupe of *Klaine-doza* (Pl. 1, j.); this resemblance is even more accentuated by the fact that the walls of young fruits of *A. mullicaule* are fleshy. The structure, described by FORMAN as an aril in *Allantospermum* is obviously of placental origin as stated by CAPURON (1965) in his excellent description :

« L'axe du fruit persiste sous forme d'une columelle portant à son sommet cinq renflements placentaires très accusés; les ovules avortés restent fixés à ces renflements. » In fact I never saw a lobed structure as depicted in FORMAN's paper. In my opinion the columellar outgrowthes are shaped as drawn in Pl. 1, b¹, b² and at least part of this structure represents the aborted ovules and can therefore not be an aril. An arilloidium, however, is present at the top of the seed, just above the hilum. In *A. mullicaule* this structure is well developed and horse-shoe shaped (CAPURON l. c. Pl. 1 f. 14-16) (Pl. 1, o). In *A. borneense* only an obscure rudiment of it is present. The funicular origin of this arilloid structure is demonstrated by the young stages, in which it forms one mass with the funicle.

In having dehiscent fruits, and seeds with an arilloid structure *Allantospermum* resembles *Ixonanthaceae* of course. As already stated, however, the dehiscent fruit of *Allantospermum* differs fundamentally from that of *Ixonanthaceae*. If we accept furthermore FORMAN's statement that an arillus is associated with dehiscent fruits and therefore does not represent an independent character these arguments for including *Allantospermum* in *Ixonanthaceae* are inconvincing from our point of view.

The stipules represent another important feature. Those of *Allantospermum* and *Irvingioideae* are intrapetiolar, and wholly (or in *Allantospermum* partially) stem clasping, while the *Ixonanthaceae* bear lateral stipules. These differences do not suggest a close affinity between *Allantospermum* and *Ixonanthaceae*.

A third character used by FORMAN to separate *Allantospermum* from *Irvingioideae* and to include it in his *Ixonanthoideae* is the lack of mucilage canals and cavities in *Allantospermum borneense*. This, of course, seems to be a difference between *Allantospermum* and the rest of *Irvingioideae*. Without detailed informations concerning the possible occurrence and the localisation of mucilage cells, cavities, and canals in all organs of both species of this genus this can hardly be accepted as convincing taxonomic evidence.

The stem anatomy of *Allantospermum* seems to differ much from that of *Irvingia*, a strange thing for genera which are so closely connected by their leaf-and flower characters. But the anatomy of *Allantospermum*

multicaule at least, also does not agree with that of *Ixonanthaceae*. It is note worthy that the anatomy of *Allantospermum* agrees quite well with that of *Humiria* (*Humiriaceae*) except for the type of vessel-perforation which is more primitive in *Humiria*. (I am much indebted to Miss Dr. A. M. W. MENNEGA, Utrecht, for this anatomical information).

In the phenolic constituents (table 2, see also NOOTEBOOM in Blumea 1967¹) *Allantospermum* agrees with *Irvingia*, *Humiria*, and with most of the *Simaroubaceae* in the occurrence of ellagic- and gallic- acid. According to BATE-SMITH (1962) these compounds are possibly of taxonomic value. Leucoanthocyanins occur in species of *Simaroubaceae*, in *Allantospermum*, in *Ochthocosmus africanus*, in *Humiria balsaminifera* and in *Cyrtlophora parvifolia*. They can give no help to our problem. In the overall patterns *Allantospermum* resembles *Irvingia* and several *Simaroubaceae*, while the chromatographic patterns of *Ixonanthaceae* are wholly different.

IRVINGIOIDEAE

As stated above *Allantospermum* belongs to *Irvingioideae* rather than to *Ixonanthoideae*. At the same time our interpretation of the fruit of *Allantospermum* excludes close affinities between this genus and *Ixonanthaceae sensu stricto*, and hence between *Irvingioideae* and *Ixonanthaceae*. At present the taxonomic position of *Irvingioideae* is still uncertain. The stipules of all genera and the anatomy of the stem of *Allantospermum multicaule* at least point to linaceous affinity indeed. On the other hand the hypogynous disk (Pl. I, fig. a and d) and the sigmoid folding of the free stamens (in *Linaceae* and related families the stamens are basally connate) in bud are shared by *Irvingioideae* and *Simaroubaceae*. Furthermore fruits leaving a central columella do also occur in *Simaroubaceae* (*Kirkia* Oliv., *Pleiokirkia* Capuron). These fruits, however, have indehiscent mericarps.

In our opinion it is wise to follow BENTHAM and HOOKER (1862) and ENGLER (1931) in treating *Irvingioideae* as belonging to *Simaroubaceae* until biological sciences have provided us with convincing evidence for a better classification of this taxon.

I am most grateful to Dr J. A. R. ANDERSON (Sarawak) and Mr. R. CAPURON (Tananarive) for sending material of *Allantospermum* and *Cleistanhopsis*, and to Mr. CAPURON and Mr. L. L. FORMAN, Kew for sending me a copy of their papers a long time before these were published.

TABLE 1. CHIEF MORPHOLOGICAL CHARACTERS

TAXON	STIPULES	STAMENS	DISK	N. OF OVULES IN EACH LOCULE	OVARY	FRUIT	SEED
<i>Iroingioideae</i>	present, intrapetiolar	10, free no adaxial scale	intrastaminal hypogynous	1	syncarpous 2- or 5- locular	drupe or samara	in <i>Klainedoxa</i> seed- coat shining and waxy. endosperm scant no aril
<i>Simaroubaceae</i>	absent (see Weber- ling & Leenhouts 1966)	± 5 or twice as many, free sometimes with an adaxial scale	intrastaminal hypogynous	1 or rarely 2	apocarpous or syncar- pous 2-5 locular	drupe or samara or 4 (8) indehis- cent mericarps, hanging from a central columella	endosperm 0 or scant, no aril
<i>Allantospermum</i>	present, intrapetiolar	10, free no adaxial scale	intrastaminal hypogynous	1	syncarpous 5-locular	capsular, the val- ves septically and partially lo- cucicidally dehis- cent, leaving a central columella	seedcoat shining and waxy, en- dosperm scant, arilodum pre- sent
<i>Cyrtloopsis</i>	present lateral	5, connate at the base no adaxial scale	absent ¹	2	syncarpous 2-locular	?	?
<i>Ixonanthaceae</i>	present lateral	5, 10, 15 or 20, connate at the base no adaxial scale	absent ¹	2	syncarpous 5-locular	5- valved capsule, the valves septi- cidally dehiscent, no central colu- mella	seedcoat not shin- ing and waxy much endosperm aril present

1. sometimes the basal connection of the filaments is regarded as a circular disk

TABLE 2. PHENOLIC CONSTITUENTS IN DRY LEAVES
(HYDROLISED LEAF-EXTRACTS OF HERBARIUM SPECIMENS)

Species ¹	K.	Q.	M.	Caff.	E.	G.	Cy.	D.
a <i>Irvingia malayana</i> (Oliv.) ex Benn.....	—	—	+	+	+	++	—	—
b <i>Allantospermum borne- ense</i> Forman.....	—	—	—	?	+	++	+	—
c <i>Allantospermum multi- caule</i> (Capuron) Noo- teboom.....	—	+	++	?	+	++	—	+
d <i>Ailanthus triphysa</i> (Den- osl.) Alst.....	+	++	?	+	++	++	+	—
e <i>Kirkia wilmsii</i> Engl....	—	+	—	+	+	++	—	—
f <i>Humiria balsamifera</i> (Aubl.) St. Hil.....	—	+	—	++	+	+	+	—
g <i>Erythroxylum cuneatum</i> (Miq.) Kurz.....	—	—	—	+	—	—	—	—
h <i>Ixonanthes grandiflora</i> Hochreut.	—	—	—	++	—	—	—	—
i <i>Occhthocosmus africanus</i> Hook. f.....	—	—	—	?	—	—	+	+
j <i>Occhthocosmus sessiliflorus</i> Baill.	—	—	—	?	—	—	—	—
k <i>Cyrtolopsis paraensis</i> Kuhlmann.....	—	—	—	—	—	—	+	+

+ present; ++ abundantly present; — not detectable; ? dubious.
K. = kaempferol; Q. = quercetin; M. = myricetin; Caff. = caffeic acid;
E. = ellagic acid; G. = gallic acid; Cy. = cyanidin; D. = delphinidin. (Cy. and D.
generated from corresponding leucoanthocyanins).

LITERATURE

BATE-SMITH, E. C. — J. Linn. Soc. Lond. Bot. 58 : 95-173 (1962).
BOAS, F. — Beih. Bot. Centralbl. 29, 1 : 348 (1913).
BENTHAM, G. & J. D. HOOKER, — Gen. Pl. 1 : 307 (1862).
CAPURON, R. — Adansonia, sér. 2, 5 : 213-226 (1965).
ENGLER, A. — Pl. Fam. 2nd ed. 19a : 123, 396 (1931).
EAELL, A. W. & F. MENDONÇA. — Bol. Soc. Brot. sér. 2, 25 : 105 (1951).
FORMAN, L. L. — Kew Bull. 19 : 517-526 (1965).
HALLIER, H. — Beih. Bot. Centralbl. 39, II : 62-68 (1923).
HEIMSCHE, C. H. — Lilloa 8 : 84-198 (1942).
HUTCHINSON, J. — Fam. Fl. Pl. 2nd ed., 2 : 256, 261. (1959).
KLOTZSCH, J. F. — Phys. Abb. K. Acad. Wiss. Berlin 1856 : 235 (1857).
KUHLMANN, J. G. — Arch. Jard. Bot. Rio de Janeiro 4 : 356, t. 29n-m (1925).

1. Material from the Rijksherbarium, Leyden. a: *Enderl 29 EP 362*; b: *S 15723*; c: *23640 SF (Capuron)*; d: *P, N. H. 37913*; e: *Ule 6142*; f: *San A 4818*; g: *F.R.I. bb 150 T 1 P 196*; h: *Léonard 199*; i: *Klaine 23*; j: *Lobley et Goddijn 1001*; k: *Ducke 34670* (from the Bot. Mus. et Herb. Utrecht).

- METCALFE, C. R. & L. CHALK. — *Anatomy of the Dicotyledons*, 2nd print, **1** : 320 (1957).
- NARAYANA, L. L. & D. RAO. — *J. Jap. Bot.* **41** : 1-9. (1966).
- NOOTEBOOM, H. P. — *Fl. Mal.* **1**, **6** : 193-226 (1962).
— *Blumea* **14** : 309-315 (1967).
— *Fl. Mal.* **1**, **6** : in press (1967).
- PIERRE, J. B. L. — *Fl. For. Coch.* **4** : 263 (1892).
- ROBSON, N. K. B. & H. K. AIRY-SHAW. — *Kew Bull.* **15** : 387-388 (1962).
- TIEGHEM, VAN — *Ann. Sc. Nat. sér. 9 Bot.* **1** : 247-320 (1905).
- WEBER, I. E. — *Amer. J. Bot.* **23** : 557-587. (1936).
- WEBERLING, F. & P. W. LEENHOUTS. — *Akad. Wiss. Lit. Abh. Naturw. Kl.* **1965** : 499-584 (1966).